HKU-Cambridge
Clean Energy & Environment
Research Platform

Funding Source:	**RGC Theme-based Research Scheme 7th Round**
Project Title:	**Big Data for Smart and Personalized Air Pollution Monitoring and Health Management**
Funding:	**HKD 50 M (USD 6.3 M)**
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Abstract

We are all entitled to live with dignity in a clean environment. With big data technologies, it is possible to collect complex, heterogeneous, high resolution, personalized, and synchronized urban air pollution, human activity, health condition, well-being, and behavioral data, enabling the generation of smart (real-time and interactive), personal alert and advice to improve the health and well-being of individual citizens, creating new business opportunities and competitive advantage for the IT and health industry in HK and beyond. There are five major challenges. FIRST, urban air quality data is sparse, rendering it difficult to provide timely personalized alert and advice. SECOND, collected data, especially those involving human inputs, such as health perception, are often missing and erroneous. THIRD, data collected are heterogeneous, and highly complex, not easily comprehensible to facilitate individual or collective decision-making. FOURTH, the causal relationships between personal air pollutants exposure (specifically $PM_{(2.5,1.0)}$ and NO_2) and personal health conditions, and health (well-being) perception, of young asthmatics and young healthy citizens in HK, are yet to be established. FIFTH, one must determine if information and advice provided can effect behavioral change. To overcome these challenges, our FIRST novelty is to develop a big data framework based on deep learning to estimate smart personalized air quality. Our SECOND novelty includes the deployment of mobile pollution sensor platforms to substantially improve the accuracy of estimated and forecasted air quality data, and the collection of activity, health conditions and perception data, accounting for human in the loop. Our THIRD novelty is the development of visualization tools, and comprehensible indexes which correlate personal exposure with four other types of personal data, to provide timely, personalized pollution, health and travel alerts and advice. Our FOURTH novelty is determining causal relationship, if any, between personal pollutants, $PM_{(2.5,1.0)}$, NO_2 exposure and personal health conditions, and also personal health perceptions, based on clinical experiments of 250 young asthmatics and 250 young healthy citizens in HK. An exposure model is developed, trained and verified with real data collected by 250 young asthmatics to further conduct population-based time series health study on 90% of asthmatics in HK. Our FIFTH novelty is an intervention study to determine if smart data, presented via our proposed system, will induce personal behavioral change. Our novel big data technologies and analytical approaches create a unique framework for personalized air pollution monitoring and e-health management, easily transferrable to and applicable in other domains and countries.

Research Impact

Academic impacts

- Novel big data framework for high precision, smart, personalized AQ monitoring & health management.
- New synchronized heterogeneous datasets.
- Improved citizen understanding & data-driven decision-making.
- Causal relationship between personal exposure (aged 12-18) to $PM_{(2.5,\ 1.0)}$ and health/health perception rigorously investigated via longitudinal exposure study.
- Rigorous personal behavior change study based on actual behavioral, instead of opinion data.
- Interdisciplinary big data framework replicable to other cities aspiring for smart, happy, healthy living.

Community Impacts (HK and Beyond)

- For citizens: clearer knowledge, smarter air pollution monitoring and health management tools, more informed choice and enhanced capacity for smart personalized healthy living/better quality of life.
- For industry and economy: personalized, synchronized datasets covering personal air pollution ($PM_{2.5,\ 1.0}$), public health and happiness, behavioral change; valuable assets for smart city analytics; stronger competitive advantage for HK's IT and healthcare industry.
- For government: Better understanding of the impact of smart policies on personal health and quality of life; significant improvement in environmental, public health and social welfare policies; enabling smart, personalized environmental and health care industries; public policies to better respond to the desire of Hong Kong residents for better air quality and personal health quality.
- Overall Impact: Smart, Happy & Healthy City Living